CLAIMS

What is claimed is:

1. A method of processing received signals, said method comprising:

receiving a combined signal at a receiving station containing mobile terminal transmissions from a plurality of mobile terminals;

despreading said combined signal to obtain a first received signal from a first mobile terminal and a second received signal from a second mobile terminal, wherein said first and second received signals each comprise a plurality of successive signal samples;

determining channel estimates for propagation channels between each of said first and second mobile terminals and said receiving station;

determining interference correlations between first and second spreading codes used respectively by said first and second mobile terminals;

computing filter coefficients of an interference suppression filter/matrix based on said channel estimates and said interference correlation; and

combining said first and second received signal with said interference suppression filter/matrix to reduce interference in said first received signal attributable to said second received signal.

2. The method of claim 1 wherein computing coefficients of an interference suppression filter/matrix based on said channel estimates and said interference correlation comprises:

determining an interference matrix A based on said channel estimates and said interference correlations;

computing said filter coefficients based on said interference matrix.

3. The method of claim 2 wherein computing said filter coefficients based on said interference matrix comprises computing the adjoint of the matrix ($A^{\#}A$) where $A^{\#}$ means "time-reversed conjugate transpose of A."

4. The method of claim 3 wherein computing said filter coefficients based on said interference matrix comprises computing the inverse of the matrix ($A^{\#}A$) where $A^{\#}$ means "time-reversed conjugate transpose of A.".

5. The method of claim 4 wherein computing the inverse of the matrix ($A^{\#}A$) comprises:

computing the adjoint of the matrix ($A^{\#}A$) to define a set of FIR filters; and

computing the determinant of the matrix ($A^{\#}A$) to determine an IIR filter.

6 The method of claim 5 wherein computing said filter coefficients based on said interference matrix further comprises deleting selected roots of said determinant and thereby deleting corresponding factors in said IIR filter.

7. The method of claim 6 further comprising canceling intersymbol interference in said first received signal by processing said first received signal through an equalizer.

8. The method of claim 7 wherein processing said first received signal through an equalizer comprises processing said first received signal with a Maximum Likelihood Sequence Estimator.

9. The method of claim 7 further comprising filtering said first received signal through a noise whitening filter ahead of said equalizer.

10. The method of claim 1 further comprising processing said first received signal in an equalizer to compensate for intersymbol interference between symbols of said first received signal.

11. The method of claim 10 wherein processing said first received signal in an equalizer to compensate for intersymbol interference between symbols of said first received signal comprises processing said first received signal with a Maximum Likelihood Sequence Estimator.

12. The method of claim 10 further comprising filtering said first received signal with a noise whitening filter ahead of said equalizer.

13. The method of claim 1 wherein determining channel estimates for propagation channels between each of said first and second mobile terminals and said receiving station comprises determining channel estimates for at least two propagation paths for each propagation channel.

14. A method of processing received signals from a plurality of mobile terminals in a diversity receiving system, said method comprising:

receiving combined signals at a plurality of receiving stations, each said combined signal containing transmissions from a plurality of mobile terminals;

despreading said combined signals at each receiving station to obtain a plurality of received signal sample streams, each received signal sample stream depending primarily on a sequence of symbols transmitted from a corresponding mobile terminal;

inputting said received signal sample streams to a central processor;

combining said received signal sample streams at said central processor so as to cancel interference in each sample stream due to symbols transmitted from mobile terminals other than that on which the sample stream primarily depends.

15. The method of claim 14 wherein combining said received signals at said central processor so as to cancel interference due to symbols transmitted from other mobile terminals comprises:

determining channel estimates corresponding to the propagation channels from each of said mobile terminals to one or more of said receiving stations;

determining the interference correlations between spreading codes used by each interfering pair of mobile terminals;

forming an interference matrix A based on said channel estimates and said interference correlations; and

combining said received signal sample streams using said interference matrix A.

16. The method of claim 15 wherein combining said received signal sample streams using said interference matrix A comprises:

combining said received signal sample streams from said plurality of mobile terminals in a diversity combiner to obtain a plurality of diversity combined signals, such that each diversity combined signal maximizes said received signals corresponding to a selected one of said mobile terminals; and

combining said diversity combined signals in an interference cancellation processor to cancel interference in said diversity combined signals due to symbols transmitted by mobile terminals other than the selected mobile terminal to which each diversity combined signal corresponds.

17. The method of claim 16 wherein combining said received signals from said plurality of mobile terminals in a diversity combiner to obtain a plurality of diversity combined signals comprises:

forming a diversity combining matrix based on said interference matrix;

multiplying a received signal vector by said diversity combining matrix; said received signal vector comprising a group of neighboring received signal samples from each of said received signal sample streams.

18. The method of claim 17 wherein forming a diversity combining matrix based on said interference matrix comprises computing the time-reversed conjugate transpose $A^{\#}$ of the interference matrix A.

19. The method of claim 16 wherein combining said diversity combined signals in an interference cancellation processor to cancel interference in said diversity combined signals comprises:

computing an interference suppression matrix based on said interference matrix A; and

further combining said diversity combined signals using said interference suppression matrix.

20. The method of claim 19 wherein computing an interference suppression matrix based on said interference matrix A comprises computing the adjoint of the product matrix ($A^{\#}A$), where $A^{\#}$ is the time-reversed conjugate transpose of A.

21. The method of claim 19 wherein computing an interference suppression matrix based on said interference matrix A comprises computing the inverse of the matrix product ($A^{\#}A$) where $A^{\#}$ is the time-reversed conjugate transpose of A.

22. The method of claim 21 wherein computing the inverse of the matrix ($A^{\#}A$) comprises:

computing the adjoint of the matrix ($A^{\#}A$) to define a matrix of FIR filters;;

computing the determinant of the matrix ($A^{\#}A$) to form an IIR filter; and

said further combining comprises filtering using said FIR filters and said IIR filter.

23 The method of claim 22 wherein computing an interference suppression matrix based on said interference matrix A further comprises deleting selected roots of the determinant of matrix ($A^{\#}A$) and thereby corresponding factors of said IIR filter.

24. The method of claim 23 further comprising canceling intersymbol interference in said received signals by processing said received signals through an equalizer.

25. The method of claim 24 wherein processing said received signals through an equalizer comprises processing said received signals with a Maximum Likelihood Sequence Estimator.

26. The method of claim 25 further comprising filtering said received signal through one or more noise whitening filters ahead of said equalizers.

27. The method of claim 15 wherein combining said received signals from said plurality of receiving stations at said central processor so as to cancel interference between received signals from other mobile terminals comprises:

combining said received signals from said plurality of mobile terminals in a diversity combiner to obtain a plurality of diversity combined signals, such that each diversity combined signal maximizes said received signals corresponding to a selected one of said mobile terminals; and

combining said diversity combined signals in an interference cancellation processor to cancel mutual interference between signals received from different mobile terminals to obtain signals containing only intersymbol interference.

28. The method of claim 27 further comprising canceling said intersymbol interference by processing each obtained signal through an equalizer.

29. The method of claim 28 wherein processing said obtained signals through an equalizer comprises processing said obtained signals with a Maximum Likelihood Sequence Estimator.

30. The method of claim 29 further comprising filtering said obtained signals through noise whitening filters ahead of said equalizers.

31. A system for processing signals received from a plurality of mobile transmitters, said apparatus comprising:

a plurality of rake receivers to despread said received signals at at least one base station to obtain a plurality of rake-combined signals, wherein each rake receiver uses a spreading code assigned to a corresponding one of said mobile terminals to obtain a received signal from said corresponding mobile terminal;

one or more channel estimators for generating channel estimates for propagation channels between each one of said mobile terminals and one or more of said base stations; and

a filter array comprising a first set of interference suppression filters for further combining said rake-combined signals to cancel mutual interference between different mobile transmitters to obtain mutual interference-free signals, and a processor to compute filter coefficients for said first set of interference suppression filters based on said channel estimates and interference correlations between interfering pairs of said mobile transmitters.

32. The system of claim 31 wherein said processor computes an interference matrix A based on said channel estimates and interference correlations between interfering pairs of said mobile transmitters, and wherein said processor computes said filter coefficients for said first set of interference suppression filters based on said interference matrix.

33. The system of claim 32 wherein said processor computes said filter coefficients for said first set of interference suppression filters by computing the adjoint of the matrix

($A^{\#}A$), where $A^{\#}$ is the time-reversed conjugate transpose of A, each element of the adjoint providing the coefficients for one interference suppression filter in said first set of interference suppression filters.

34. The system of claim 32 further comprising a second set of interference suppression filters to compensate for intersymbol interference between symbols transmitted by the same mobile transmitter.

35. The system of claim 34 wherein said processor computes said filter coefficients for said second set of interference suppression filters by computing the determinant of the matrix ($A^{\#}A$) where $A^{\#}$ is the time-reversed conjugate transpose of A.

36. The system of claim 35 wherein said processor further computes said filter coefficients for said second set of interference suppression filters by determining the roots of said determinant and deleting selected roots for each interference suppression filter in said second set of interference suppression filters to obtain shortened interference suppression filters.

37. The system of claim 36 further comprising one or more equalizers to process the outputs of said shortened filters to compensate for intersymbol interference between symbols from the same mobile transmitter.

38. The system of claim 37 further comprising one or more noise whitening filters disposed between said first set of interference suppression filters and said equalizers to whiten noise in said received signals.

39. The system of claim 31 further comprising one or more equalizers to process said mutual interference-free signals to compensate for intersymbol interference between symbols transmitted by the same mobile transmitter.

40. The system of claim 39 in which said equalizers are Maximum Likelihood Sequence Estimation.

41. The system of claim 40 further comprising one or more noise whitening filters disposed between said first set of interference suppression filters and said equalizers to whiten noise in said received signals.